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(54) An interface circuit for an infrared detector

(57) A security circuit (1) comprises three IR detectors (4) connected to a central control panel (2) by a two wire circuit (5). An interface circuit (12) having a pair of input terminals (14,15) connect an IR sensor (10) of each detector (4) to the two wire circuit (5). Each IR detector (4) comprises three identifying resistors (R4A,R4B,R4C) of different values of resistance for facilitating identification of the IR detector (4) which has detected an alarm condition. A transistor (TR1) which is responsive to the IR sensor (10) connects one of the resistors (R4A,R4B,R4C) across the input terminals (14,15) on an alarm condition being detected by the IR sensor 10, thus altering the current being drawn from the central control panel (2). A different one of the resistors (R4A,R4B,R4C) are connected by a connecting bridge (27) across connection terminals (26) into the interface circuits 12 of the respective IR detectors 4, so that each detector (4) draws a different current on an alarm condition existing.

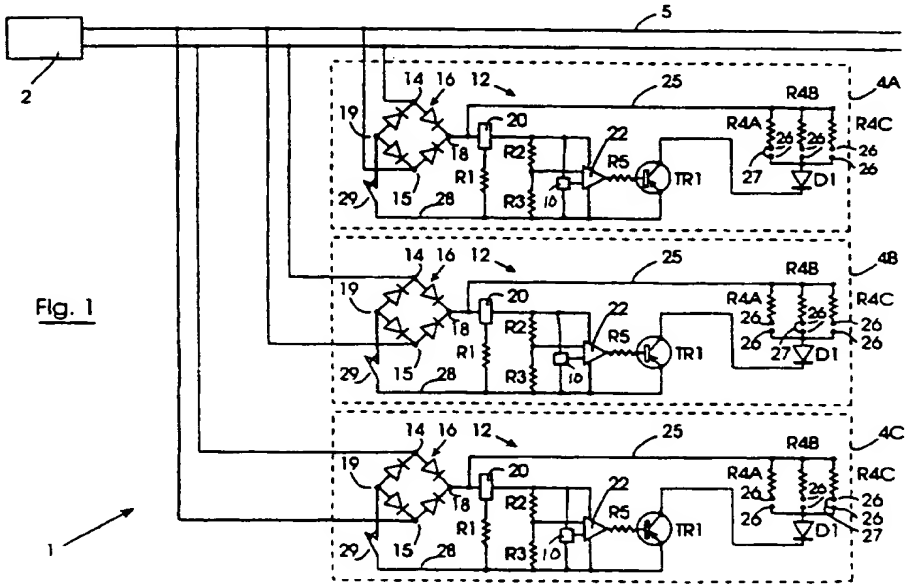

Fig. 1

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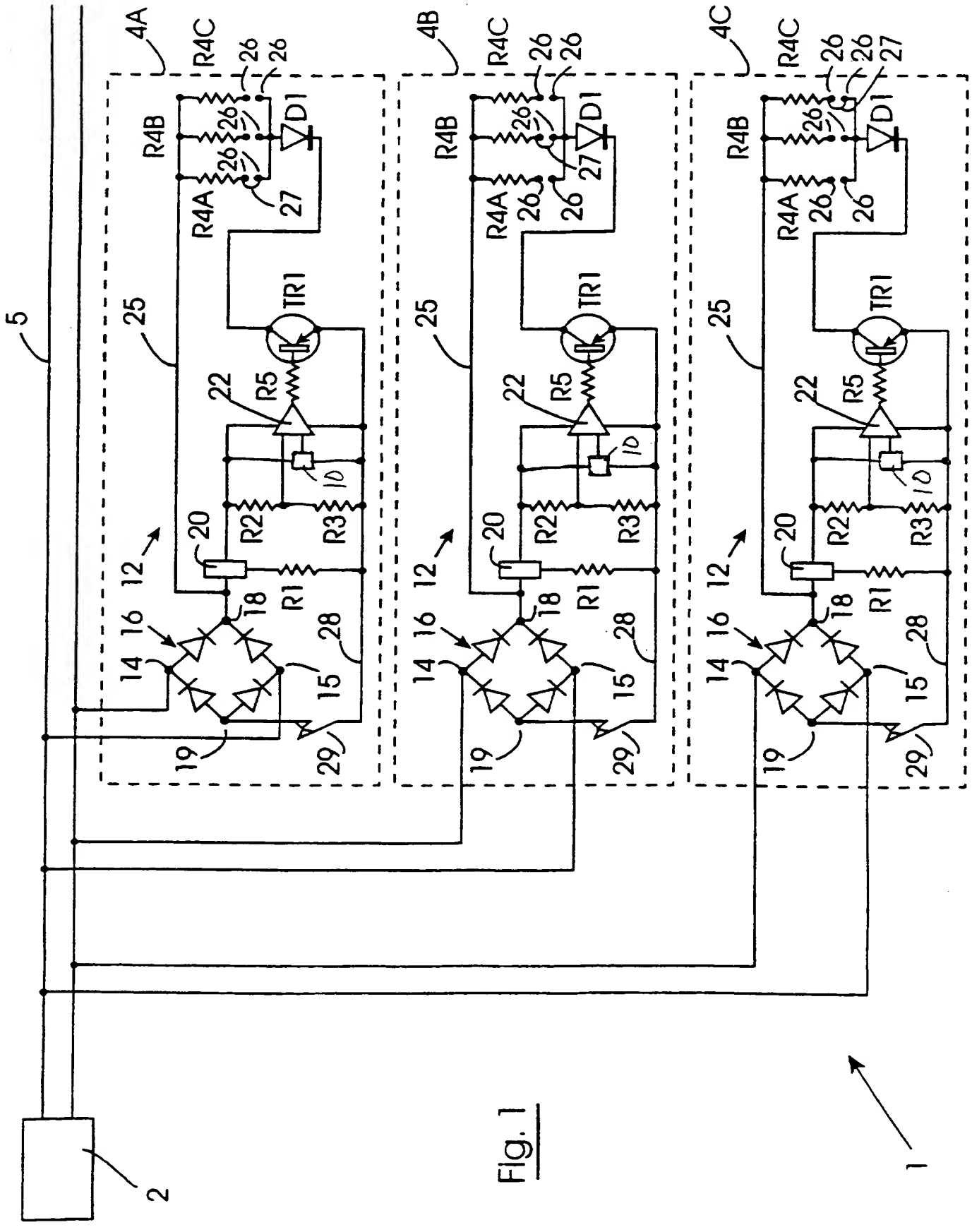
5
4A
4B
4C
R4C
R4B
R4A
D1
TR1
R5
R2
R3
R1
10
12
14
16
18
19
20
22
25
26
27
28
29
1
2

Fig. 1

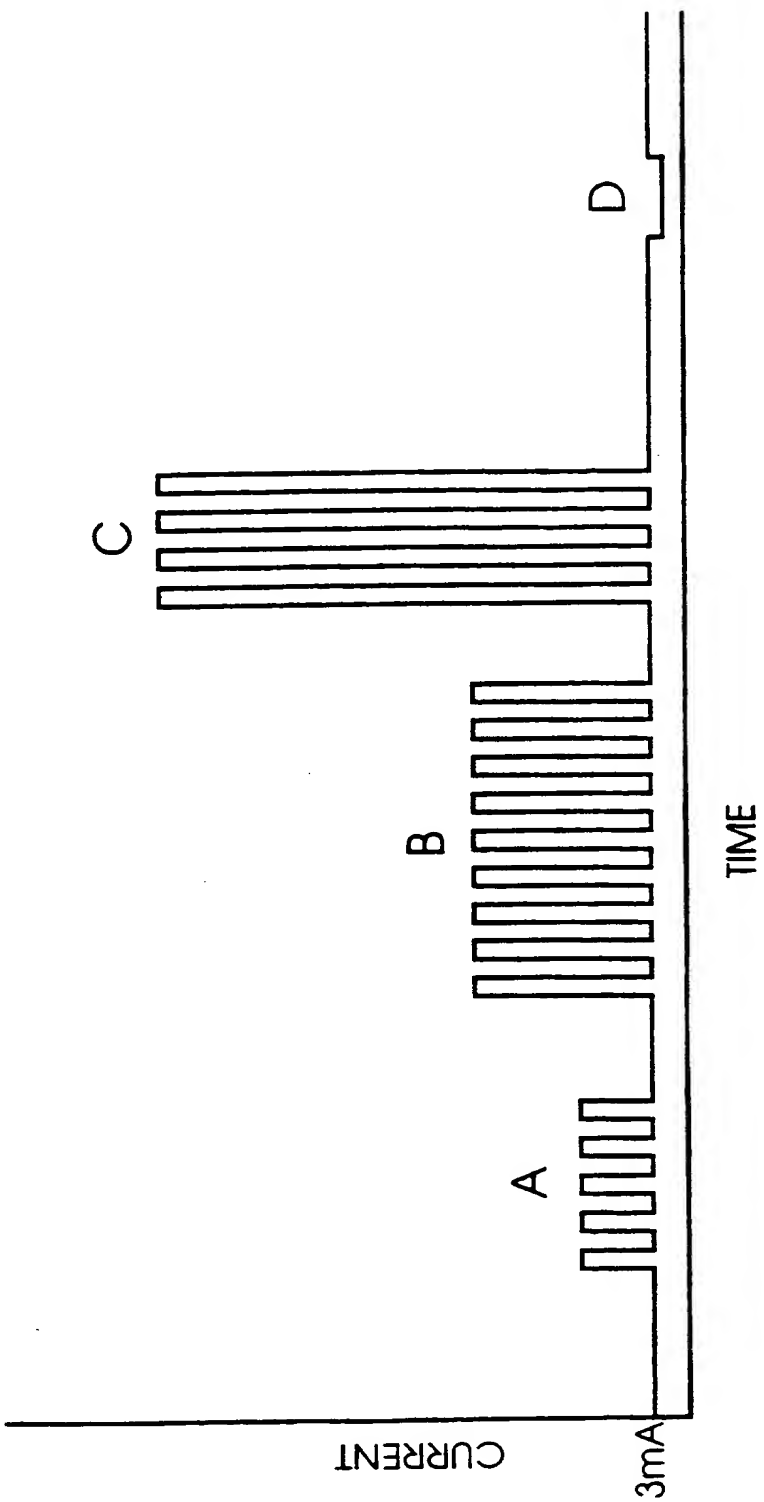

Fig. 2

"An interface circuit for an infrared detector"

The present invention relates to an interface circuit for interfacing an infrared sensor, hereinafter referred to as an IR sensor of an infrared detector, hereinafter referred to as an IR detector with a circuit for connecting the IR detector to a central control panel for supplying power to and monitoring the IR detector. The invention also relates to an IR detector incorporating the interface circuit, and to a security circuit from a control panel comprising one or more of the IR detectors.

IR detectors are well known for use in security circuits, for example, for use in the detection of an intruder or the like in a building. Such IR detectors, in general, comprise an IR sensor which is located at the focal point of a segmented mirror, and a heat source in the beams of the respective mirror segments are reflected back to the IR sensor. On the IR sensor detecting a change in the heat source in a beam the IR sensor outputs a signal to a control circuit within the IR detector, which in turn, changes the state of a bi-state switch within the IR detector for interrupting or applying a signal to a pair of wires of a circuit from a central control panel. On the central control panel detecting the change in the state of the switch an

alarm is raised by the central control panel.

Such IR detectors require a minimum of four wires, and in general six wires are required for connecting the IR detector to the central control panel. Two wires are required for supplying a power supply to the IR detector for powering the IR sensor and the control circuitry in the detector. Two more wires are required for relaying the signal from the switch of the IR detector which has changed state as a result of detection of an intruder by the IR sensor. Two further wires, in general, are required for connecting to a tamper switch of the IR detector for indicating if the IR detector has been tampered with. Additionally, unless each of a plurality of IR detectors are wired individually to separate zones of a central control panel, the central control panel is unable to identify which one of the plurality of IR detectors has changed state as a result of its IR sensor detecting an alarm condition. Accordingly, where two or more IR detectors are connected by a circuit to a single monitoring zone of a central control panel it is impossible for the central control panel to identify the location within a building in which an alarm conditions prevails. This is undesirable.

Furthermore, since the switch of the IR detector which

is responsive to the IR sensor detecting an alarm condition merely changes state as a result of an alarm condition being detected. It is not possible for the central control panel to determine the type of alarm condition, nor indeed is it possible for the central control panel to analyses the type of alarm condition which prevails. For example, in many cases, if an IR detector is not correctly located in a room or otherwise of a building, the IR detector may be activated by events occurring outdoors, or externally of the area to be monitored by the IR detector. For example, headlights of a car being detected in the beam of an IR sensor may be sufficient to initiate an alarm condition. This also, is undesirable.

Accordingly, there is need for an IR detector and an interface circuit for the IR detector which overcomes these problems of known prior art IR detectors. There is also a need for an IR detector which is suitable for connecting along with at least one other IR detector to a central control panel by means of a single two wire circuit, and which facilitates identification of the IR detector at which an alarm condition exists.

The present invention is directed towards providing such an IR detector, an interface circuit for connecting the IR detector to a two wire circuit from a

central control panel, and the invention is also directed towards providing a security circuit incorporating at least two IR detectors according to the invention.

According to the invention there is provided an interface circuit for connecting an IR sensor of an IR detector to a two wire circuit, to which at least one other similar type of IR detector is connected, the interface circuit comprising a pair of input terminals for connecting the interface circuit to the two wire circuit, a voltage regulating means for deriving a voltage supply through the input terminals from the two wire circuit, and for providing a regulated voltage supply to the IR sensor for powering thereof, an identifying impedance means for facilitating identification of the IR detector, and a main switch means responsive to the IR sensor for selectively switching the identifying impedance means across the input terminals for altering the impedance of the interface circuit.

In one embodiment of the invention the main switch means comprises a transistor, the base of which is controlled by the IR sensor output.

Preferably, a plurality of identifying impedance means

are provided, and a secondary switch means is provided for selectively switching one or more of the plurality of identifying impedance means to the main switch means for facilitating selection of a value of impedance of the identifying impedance means of the interface circuit which is different to the value of the impedance of the identifying impedance means of the interface circuit of one or more other infrared detectors connected to the two wire circuit.

Advantageously, the impedance value of at least some of the plurality of identifying impedance means are different to each other.

In one embodiment of the invention each identifying impedance means comprises a resistor.

In another embodiment of the invention an amplifying means is provided for amplifying the output signal from the IR sensor for delivery to the main switch means.

In a further embodiment of the invention a rectifying means is disposed at the pair of input terminals for receiving a voltage supply from the two wire circuit and for relaying the voltage supply to the voltage regulating means.

In one aspect of the invention a light emitting diode is switched across the input terminals by the main switch means.

In another embodiment of the invention a tamper indicating means is connected to the interface circuit for indicating tampering with the IR detector. Preferably, the tamper indicating means comprises a bi-state switch, which is connected in series with one of the input terminals and the interface circuit.

Additionally the invention provides an IR detector comprising an IR sensor, and an interface circuit according to the invention, the interface circuit being connected to the IR sensor for connecting the IR sensor to a two wire circuit so that the IR sensor may be powered and monitored by the two wire circuit.

Further the invention provides a security circuit comprising a two wire circuit, and at least two IR detectors according to the invention connected to the two wire circuit by the interface circuit.

In one embodiment of the invention a control panel is connected to the two wire circuit for supplying power to an monitoring the IR detectors connected thereto.

The invention will be more clearly understood from the following description of a preferred embodiment thereof which is given by way of example only with reference to the accompanying drawings, in which:

Fig. 1 is a circuit diagram of a security circuit according to the invention comprising a central control panel and three IR detectors according to the invention connected to the central control panel, and

Fig. 2 is a graphical representation of output signals from the respective three IR detectors of Fig. 1.

Referring to the drawings and initially to Fig. 1 there is illustrated a security circuit according to the invention which is indicated generally by the reference numeral 1. The security circuit 1 comprises a central control panel 2 and three IR detectors 4A, 4B and 4C which are connected to the central control panel 2 by a two wire circuit 5. The central control panel 2 comprises a power supply (not shown) for supplying a substantially constant 12V DC power supply across the wires of the two wire circuit 5. A microprocessor (also not shown) is provided in the central control panel 2 for analysing the current flowing in the two

wire circuit 5 for determining if an alarm condition has been detected by any of the IR detectors 4, and also for determining which of the IR detectors 4 have detected the alarm condition.

The three IR detectors 4 are identical to each other, and only one of the IR detectors 4, namely, the detector 4A will be described in detail. The detector 4A comprises an IR sensor 10, which when the detector 4 is located in an area of a building, typically, a room, office or the like scans the area for determining if an intruder is present in the room or office. The IR sensor 10 is of the type which includes a segmented mirror (not shown), and the IR sensor 10 is located at the focal point of the segmented mirror. The IR sensor 10 is sensitive to a heat source in any of the beams reflected by the segmented mirror onto the IR sensor 10. On the IR sensor 10 determining that a change in heat has occurred in the area within the beams reflected by the segmented mirror, the output from the IR sensor 10 is altered to indicate an alarm condition. Such IR sensors 10 will be well known to those skilled in the art.

An interface circuit also according to the invention and indicated generally by the reference numeral 12 is provided for connecting the IR sensor 10 to the two

wire circuit 5 as will be described below. The interface circuit 12 comprises a pair of input terminals 14 and 15 for connection to the respective wires of the two wire circuit 5. A rectifying bridge circuit 16 connected to the input terminals 14 and 15 receives the power supply on the two wire circuit 5, and relays the power supply to the interface circuit 12 so that terminals 18 and 19 of the bridge circuit 16 which supply the interface circuit 12 are always positive and negative respectively irrespective of how the input terminals 14 and 15 are connected to the two wire circuit 5.

A voltage regulator 20 is supplied by the bridge circuit 16 and regulates the supply voltage on the two wire circuit 5 for supplying a voltage of approximately 6V to the IR sensor 10. A resistor R1 connects the voltage regulator 20 to the negative terminal 19 of the bridge circuit 16. The IR sensor 10 is connected across the 6V supply of the voltage regulator 20. A potential divider comprising resistors R2 and R3 are connected across the 6V supply of the voltage regulator 20 for providing a reference voltage input to a reference voltage input pin of a comparator amplifier 22. The output from the IR sensor 10 is connected to the other input pin of the comparator amplifier 22. The values of the resistors R2 and R3 are selected so

that the voltages applied to the reference input pin of the comparator amplifier 22 and the voltage output from IR sensor 10 which is applied to the other input pin of the comparator amplifier 22 are similar when no alarm condition exists, but on an alarm condition existing the voltage applied by the IR sensor 10 on the input pin changes thereby altering the output on the output pin of the comparator amplifier 22. The comparator amplifier 22 is powered by the regulated 6V voltage supply from the voltage regulator 20.

A plurality of identifying impedance means, namely, identifying resistors R4A, R4B and R4C are connected to the positive terminal 18 of the bridge circuit 16 by a positive wire 25. A main switch means, namely, a transistor TR1, and a plurality of secondary switch means, namely, manual connection terminals 26 are provided for selectively connecting one or more of the identifying resistors R4A, R4B and R4C to the negative terminal 19 of the bridge circuit 15 through a negative wire 28. The output of the comparator amplifier 22 is fed to the base of the transistor TR1 through a resistor R5 so that the transistor TR1 is responsive to the IR sensor 10 detecting an alarm condition for switching one or more of the identifying resistors R4A, R4B and R4C across the terminals 18 and 19 of the bridge circuit 16, and in turn, the input terminals 14

and 15 of the interface circuit 12. The connection terminals 26 are provided for allowing manual selection of one or more of the identifying resistors R4A, R4B and R4C for facilitating determination at which IR detector an alarm condition prevails. The resistance values of the resistors R4A, R4B and R4C are all different for enabling identification of the IR detector 4 which has detected an alarm condition. In this embodiment of the invention since only three IR detectors 4 are to be connected by the two wire circuit 5 to the control panel 2 only one of the identifying resistors R4A, R4B and 4RC are selected in each of the IR detectors 4. In the IR detector 4A the identifying resistor R4A is selected by bridging the connection terminals 26 which are associated with the identifying resistor R4A by a conductive bridge 27. In the IR detector 4B the identifying resistor R4B is selected, and in the IR detector 4C the identifying resistor R4C is selected.

Thus, on any of the IR detectors 4A, 4B and 4C detecting an alarm condition, the selected identifying resistor R4A, R4B or R4C of that IR detector 4 is connected across the input terminals 14 and 15 by the transistor TR1, and thus, across the two wire circuit 5. This alters the impedance of the interface circuit 12 of the IR detector 4 at which the alarm condition

prevails, and thus the impedance of the two wire circuit 5. The altered impedance of the two wire circuit 5 causes the current drawn by the two wire circuit 5 to change, which is detected by the central control panel 11, which determines the existence of an alarm condition. By analysing the current signal flowing in the two wire circuit 5, the control panel 2 may make an immediate determination as to which of the IR detectors 4 have detected an alarm condition.

A light emitting diode D1 is connected in series with the relevant identifying resistor R4A, R4B and R4C so that when the transistor TR1 of the IR detector 4 at which an alarm condition prevails is switched on, the light emitting diode D1 glows, thus giving a visual indication on the IR detector 4 that the IR detector 4 has detected an alarm condition.

In this embodiment of the invention each IR detector 4 when in a passive state, in other words, when no alarm condition prevails draws a current of approximately 1mA from the two wire circuit 5. Thus, with the three IR detectors 4 connected to the two wire circuit 5 in a passive state, a current of 3mA is drawn from the central control panel 2 on the two wire circuit 5. On any of the IR detectors 4 detecting an alarm condition the resistor R4 of the IR detector 4 which detects the

alarm condition is switched across the input terminals 14 and 15, and in turn the two wire circuit 5, thus increasing the current which is draw through the two wire circuit 5 from the central control panel 2. The amount of increase in the current depends on the value of the resistor R4 which is switched across the input terminals 14 and 15 of the interface circuit 12. Accordingly, by analysing the amplitude of the current signal being drawn in the two wire circuit 5 the control panel 2 may immediately determine by which IR detector 4 an alarm condition has been detected.

Because the transistors TR1 of the IR detectors 4 are switched directly by the output of the corresponding IR sensor 10, the transistor TR1 is pulsed on and off as an intruder or other heat source which caused the alarm condition moves relative to the IR detector 4, through the beams reflected by the segmented mirror. This, thus, causes a pulsed current signal to be drawn from the control panel 2 on the two wire circuit 5. The graph of Fig. 2 illustrates a typical type of pulsed current signal which is drawn from the control panel 2 on any one of the respective IR detectors 4A, 4B and 4C detecting an alarm condition. The pulsed current signal A represents the pulsed current signal drawn from the central control panel 2 on the detector 4A having detected an alarm condition. The value of the

identifying resistor R4A is such as to cause the current being drawn to increase from 3mA to 10mA. The pulsed current signal B represents the pulsed current signal drawn from the central control panel 2 on the detector 4B having detected an alarm condition. The value of the identifying resistance R4B is such as to increase the current drawn from the central control panel from 3mA to 15mA. The pulsed current signal C represents the current drawn from the central control panel 2 on the detector 4C detecting an alarm condition. The value of the identifying resistor R4C is such as to increase the current being drawn from 3mA to 20mA.

Accordingly, by monitoring the amplitude of the current signal drawn from the central control panel 2, and by comparing current values with reference values in a suitable look-up table, the central control panel 2 can readily identify the IR detector 4A, 4B or 4C which has detected an alarm condition. Additionally, by analysing the mark space ratio of the pulsed current signals A, B and C the central control panel 2 can determine whether or not the alarm condition is caused by an intruder, or by a false alarm situation, such as, for example, a source outside the building or area being monitored by the relevant IR detector 4. In general, the pattern of the pulsed current signal, and

the mark space ratio differs from an intruder moving around within a building to that caused by an external source, and by suitably programming the central control panel 2, the central control panel 2 is able to differentiate between a signal caused by an intruder and a signal caused by an external source. This, thus, avoids the control panel 2 indicating an alarm condition when in actual fact the condition detected by the detector 4 would have been a false alarm.

Should an alarm condition on one of the detectors 4 continue, and simultaneously while the alarm condition continues, a second of the three IR detectors detects an alarm condition, the microprocessor in the central control panel 2 also determines at which two detectors the alarm condition prevails, by merely comparing the amplitude of the pulsed current signal with reference amplitudes of various summed combinations of amplitude signals which would occur depending on the combination of IR detectors 4 which detected an alarm condition. Such reference summed amplitude values may be provided in a look-up table in the microprocessor.

It is important that the values of the resistors R5A, R5B and R5C should be chosen so that where two IR detectors 4 are simultaneously activated as a result of an alarm condition, the central control panel 2 can

identify the two IR detectors 4 which are in an alarm condition.

A tamper indicating means, namely, a bi-state tamper indicating switch 29 is located in the negative wire 28 of each interface circuit 12 for indicating if an attempt is made to tamper with one of the IR detectors 4. Typically, the IR detectors 4 comprise a two part housing which when secured together form a hollow interior region within which the components of the IR detector 4 are located. The tamper indicating switch 29 is of the type which is mounted within the hollow interior region, and is retained normally closed, while the two parts of the housing are secured together. However, on an attempt being made to prise one part of the housing apart from the other, the tamper indicating switch 29 opens, thereby opening the circuit through the interface circuit from the input terminal 14 to the input terminal 15. This, thus, prevents the IR detector 4 which has been tampered with from drawing current from the two wire circuit 5 and accordingly, the current being drawn through the two wire circuit 5 drops from 3mA to 2mA. The signal D in the graph of Fig. 2 illustrates the current which is drawn through the two wire circuit 5 in the event of the tamper indicating switch 29 of one of the IR detectors 4 going on open circuit. Needless to say, if a second of the

IR detectors 4 is tampered with, and the tamper indicating switch 29 of that IR detector 4 goes on open circuit, the current being drawn through the two wire circuit 5 drops to 1mA, and if all three tamper indicating switches 29 opened the current drawn in the two wire circuit 5 drops to zero.

Since on being tampered with, the tamper indicating switch 29 of an IR detector 4 goes on open circuit, thus causing a drop in the current being drawn in the two wire circuit 5, the central control panel 2 can readily easily differentiate between an attempt to tamper with an IR detector, and an IR detector detecting an alarm condition.

The advantages of the IR detector 4 and the interface circuit 12 according to the invention are many. A particularly important advantage is achieved by virtue of the fact that the same two wires which connect the one or more detectors 4 to the central control panel 2 may be used for both supplying power to the IR detectors 4, and monitoring the state of the IR detectors 4. Additionally, when a tamper indicating switch 29 is included in the interface circuit 12, tampering with the IR detectors may also be monitored on the same two wires. This has significant savings in wiring, and also savings in the cost and time incurred

in installing a security system which includes more than one IR detector.

Furthermore, by virtue of the fact that the identity of each IR detector 4 can be determined by analysing the amplitude of the current being drawn from the central control panel 2, the central control panel 2 can readily easily identify the IR detector which has detected an alarm condition.

Furthermore, by virtue of the fact that the signal being applied to the two wire circuit 5 is in direct proportion to the output of the IR sensor 10 in the respective IR detectors 4, by analysing the mark space ratio of the current being drawn by the IR detectors 4, a more accurate determination of the cause of the alarm condition, whether it is caused by an intruder, or a false alarm may be made. This is a particularly important advantage, since in general, it significantly minimises false alarms. It will be appreciated that this advantage may be readily achieved by virtue of the fact that the processing power of a central control panel, in general, is significantly greater than the processing power of IR detector circuits known heretofore. Additionally, by virtue of the fact that the micro-processor of the central control panel determines which IR detector has detected an alarm

condition, and whether the alarm condition is caused by an intruder or a false alarm, the processing power which is required in the respective IR detectors is significantly reduced, thus, significantly reducing the cost of the IR detectors.

Even although only two wires are required to connect the IR detectors according to the invention to the central control panel, the central control panel can readily easily differentiate between a tamper signal and an alarm signal, and also can identify which IR detector has detected an alarm condition. Furthermore, the central control panel in general, is also capable of differentiating between an actual alarm condition and a false alarm, and the same two wire are used for powering and monitoring the IR detectors.

CLAIMS

1. An interface circuit for connecting an IR sensor of an IR detector to a two wire circuit, to which at least one other similar type of IR detector is connected, the interface circuit comprising a pair of input terminals for connecting the interface circuit to the two wire circuit, a voltage regulating means for deriving a voltage supply through the input terminals from the two wire circuit, and for providing a regulated voltage supply to the IR sensor for powering thereof, an identifying impedance means for facilitating identification of the IR detector, and a main switch means responsive to the IR sensor for selectively switching the identifying impedance means across the input terminals for altering the impedance of the interface circuit.

2. An interface circuit as claimed in Claim 1 in which the main switch means comprises a transistor, the base of which is controlled by the IR sensor output.

3. An interface circuit as claimed in Claim 1 or 2 in which a plurality of identifying impedance means are provided, and a secondary switch means is provided for selectively switching one or more of the plurality of identifying impedance means to the main switch means for facilitating selection of a value of impedance of

the identifying impedance means of the interface circuit which is different to the value of the impedance of the identifying impedance means of the interface circuit of one or more other infrared detectors connected to the two wire circuit.

4. An interface circuit as claimed in Claim 3 in which the impedance value of at least some of the plurality of identifying impedance means are different to each other.

5. An interface circuit as claimed in any preceding claim in which each identifying impedance means comprises a resistor.

6. An interface circuit as claimed in any preceding claim in which an amplifying means is provided for amplifying the output signal from the IR sensor for delivery to the main switch means.

7. An interface circuit as claimed in any preceding claim in which a rectifying means is disposed at the pair of input terminals for receiving a voltage supply from the two wire circuit and for relaying the voltage supply to the voltage regulating means.

8. An interface circuit as claimed in any preceding

claim in which a light emitting diode is switched across the input terminals by the main switch means.

9. An interface circuit as claimed in any preceding claim in which a tamper indicating means is connected to the interface circuit for indicating tampering with the IR detector.

10. An interface circuit as claimed in Claim 9 in which the tamper indicating means comprises a bi-state switch, which is connected in series with one of the input terminals and the interface circuit.

11. An interface circuit substantially as described herein with reference to and as illustrated in the accompanying drawings.

12. An IR detector comprising an IR sensor, and an interface circuit as claimed in any preceding claim, the interface circuit being connected to the IR sensor for connecting the IR sensor to a two wire circuit so that the IR sensor may be powered and monitored by the two wire circuit.

13. An IR detector substantially as described herein with reference to and as illustrated in the accompanying drawings.

14. A security circuit comprising a two wire circuit, and at least two IR detectors as claimed in Claim 12 or 13 connected to the two wire circuit by the interface circuit.

15. A security circuit as claimed in Claim 14 in which a central control panel is connected to the two wire circuit for supplying power to an monitoring the IR detectors connected thereto.

16. A security circuit substantially as described herein with reference to and is illustrated in the accompanying drawings.

The Patent Office

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Application No: GB 9616570.9
Claims searched: 1-16

Examiner: Steven Davies
Date of search: 12 December 1996

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): G4H-HNHA

Int Cl (Ed.6): G08B-25/00, 25/01, 25/04

Other:

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
A	GB 2297410 A	(CETSA) e.g. Fig.1	
A	GB 2111273 A	(GATEWAY) e.g. page 2, lines 100-109	
A	US 3991413	(BERGER) e.g. Fig.1	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.